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ROAD BUSINESS

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The short time available to us during New Hampshire's spring and summer seasons is extremely valuable. Frequently, we are tyring to get twelve months of work done in a four month period. This issue of Road Business *has been put together as a special report for all the individuals who will be involved in the maintenance and construction of New Hampshire's rural roads. The articles below will be of particular interest to you if you are involved in bridge maintenance, pothole repair, paving projects, or road drainage problems. In our next issue we will return to our usual format featuring "On The Road In New Hampshire."*

SPECIAL REPORT

Winter Is Never Over In NH

Linseed oil for the protection of concrete structures

The problem of protecting bridge decks, parking ramps, curbs, sidewalks, and other concrete surfaces from the ravages of winter is as old as the use of concrete itself. In spite of its smooth, rock-hard appearance, small, almost microscopic pores exist in the concrete surface. During the warmer months, moisture evaporates rapidly from these pores with no harm to the surface. In the winter, however, freezing water can cause measurable surface damage. At lower temperatures, water in the pores freezes and remains solid until the temperature rises enough to permit thawing. Several freeze-thaw cycles may occur during an average winter day. Since water expands when frozen, the effect of repeated freeze-thaw cycles is to initiate scaling and later spalling of the top surface. This is particularly true for concrete less than four years old.

The problem is aggravated by the use of most de-icing agents. These agents react with concrete and markedly accelerate the deterioration process. In particular, chlorides will penetrate concrete and cause corrosion of reinforcing steel. As the level of chlorides in concrete becomes excessive, the rate of corrosion increases. Reducing the ease with which clorides penetrate concrete surfaces is an effective means of preventing corrosion of rebar and subsequent concrete deterioration.

The scaling and pitting which beset concrete surfaces, often after a single winter, point up a problem which urgently demands a solution. Two possible approaches to this problem are the use of air-entrained concrete and protective coatings, such as linseed oil.

Prominent among the corrective measures suggested is the use of air-entrained concrete. This material contains myriads of tiny air bubbles distributed more or less evenly throughout the mass. The air bubbles help to inhibit scaling and spalling due to freeze-thaw cycles and the use of de-icing chemicals. Today practically all new concrete highway construction uses air-entrained concrete.

Air-entrained concrete failures occur frequently enough to be a source of serious concern to highway maintenance engineers. Plausible explanations, such as incorrect quantity of entrained air, improper formulation, inferior quality of aggregate, excessive trowelling of the top

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Protection of Concrete...
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surface, etc., are often offered when air-entrained concrete fails in service. The fact remains that failures continue to occur and while more vigilant and costly inspection at the time of placing the concrete may obviate some of these difficulties, it could not entirely eliminate the possibility of human error.

Protective coatings are harmless, easily applied, low-cost materials, which can be applied in thin coats to seal the pores of the concrete and thus prevent the entrance of water and corrosive solutions. These are a practical means of correcting the trouble at its source. Although we will primarily review linseed oil as a protective coating, various other substances, such as synthetic resins, silicates, and silicones have also been suggested as protective coatings for concrete. One major manufacturer of synthetic resins has recently undertaken an advertising campaign in national magazines to call public attention to the problem and to highlight the need for winter roadway protection.

The water-repellency characteristics of linseed oil films suggested, many years ago, its application for this purpose. The Portland Cement Association and the Salt Institute have pointed out the value of linseed oil as a protective coating for non-air-entrained concrete. Others have even suggested the use of boiled linseed oil for additional protection with non-air-entrained concrete. A number of state, county, and municipal highway departments have used and are still using linseed oil for both types of concrete.

To apply a protective coating of linseed oil costs around $.10 per square yard for materials. While application costs can vary, estimates indicate that this will not exceed an additional $.10 per square yard when readily-available, efficient spreading equipment is used.

Double-boiled linseed oil is preferred to raw oil because of its more rapid dryng and film-forming characteristics. To decrease the viscosity and facilitate spreading, it is common practice to mix the oil with an equal volume of mineral spirits.

When the mixture is used, it is customary to apply two coats, the first at .025 gallons per square yard. When this has thoroughly dried, it is followed by a second coat applied at the rate of .015 gallons per square yard.

For more information on using boiled linseed oil as a protective coating on concrete surfaces, see the directions printed on page 3 of this newsletter.

The above article was written for *Road Business* by Harvey S. Goodwin, Assistant Bridge Maintenance Engineer, NH DOT ■

Directions For Using Boiled Linseed Anti-Spalling Compound

Protect your concrete surfaces

Linseed anti-spalling compound protects concrete surfaces in two ways: by penetrating the porous surface of the concrete to a depth of approximately ⅛"; and by combining with atmospheric oxygen to form a protective coating through which destructive moisture and salt solutions cannot penetrate.

Uses: Linseed anti-spalling compound is used to protect roads, bridge decks, sidewalks, curbs, abutments, endposts, concrete handrails, and all exposed concrete surfaces from de-icing agents. Usually, it is not applied to the undersides and backsides of structures which are less exposed to chlorides.

For more information, see the article on the front page of this newsletter.

Material: 50% double boiled linseed oil and 50% petroleum spirits (AASHTO M-233-79 Type II).

Time of Application: Surfaces should be cleaned and washed annually in the spring of the year and oiled every two years. Linseed anti-spalling compound can be used on new and old concrete.

The oil is most effective if applied to new concrete upon completion of the initial curing period, usually considered to be about 28 days after placement. However, it has been successfully applied to new concrete after 2 weeks curing.

Linseed anti-spalling compound can be applied to concrete of any age. However, it is most effective in preserving sound concrete surfaces.

Pre-application conditions:

(1) The concrete should be dry and the solution should not be applied within 24 hours of a rainstorm.

(2) Remove sand and debris from joints, drains and bridge shoes (use high pressure water wash and let dry 24 hours).

(3) New concrete should be at least two weeks old. Ideally, it should be 28 days old.

(4) The ideal atmospheric temperature at the time of application is 70 degrees Fahrenheit or above. Successful applications have been made, however, at temperatures as low as 35 degrees Fahrenheit.

Application: Two coats are recommended, applied as follows:

1st Coat: 0.25 gal. per sq. yd. (40 sq. yds. per gal.)
2nd Coat: 0.15 gal. per sq. yd. (67 sq. yds. per gal.)

Application may be by spray or hand but should be uniform. The coverage of *each* coat shall *not* be more than 50 square yards per gallon of the mixture. When applying the mixture to concrete surfaces, the contractor should take all necessary precautions to ensure that the mixture does not contaminate adjoining asphalt pavements. The mixture will cause a potential safety hazard by making the asphalt pavement slippery. Also, the petroleum based linseed oil mixture may have a tendency to weaken the asphalt.

Complete drying should be permitted between coats. At temperatures of 70 degrees Fahrenheit or above, drying is complete within a few hours. At lower temperatures, proportionately longer drying times are required.

CAUTION: Linseed anti-spalling compound has a flash point around 120 degrees Fahrenheit. While not dangerously flammable, it nevertheless should not be heated.

Care should be exercised to cover the concrete surface completely, including all edges, which are sometimes missed in spraying. Maximum protection is afforded only when coverage is complete.

The preceding information has been provided by Harvey S. Goodwin, Assistant Bridge Maintenance Engineer, NH DOT. ■

Paving Materials...
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It consists of well-graded, high-quality aggregate and asphalt cement. The asphalt and aggregate are heated separately from 250 to 325 degrees Fahrenheit, carefully measured and proportioned, then mixed until the aggregate particles are coated with asphalt. Mixing is done in the pugmill unit of the mixing plant. The hot mixture, kept hot during transit, is hauled to the construction site, where it is spread on the roadway by an asphalt paving machine. The smooth layer from the paver is compacted by rollers to proper density before the asphalt cools.

Asphalt concrete is but one of a variety of hot-asphalt plant mixes. Other mixes, such as sand asphalt, sheet asphalt, and coarse-grade mixes are prepared and placed in a similar manner. However, they have one common ingredient—asphalt cement.

Asphalt mixes containing liquid asphalt also may be prepared in central mixing plants. The aggregate may be partially dried and heated or mixed as it is withdrawn from the stockpile. These mixes are usually referred to as cold mixes, even though heated aggregate may have been used in the mixing process.

Asphalt mixtures made with emulsified asphalt and some cutback asphalts can be

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